

PHOSPHINE

Phosphine is a federal hazardous air pollutant and was identified as a toxic air contaminant in April 1993 under AB 2728.

CAS Registry Number: 7803-51-2

PH₃

Molecular Formula: H₃P

Phosphine is a poisonous gas which has an odor of decaying fish. It is spontaneously flammable in air if there is a trace of P₂H₄ present and burns with a luminous flame. Phosphine is slightly soluble in water, alcohol, ether, and cuprous chloride. When passed over heated metal it liberates hydrogen and forms the phosphide. Phosphonium salts occur when phosphine is brought in contact with halogen acids (HSDB, 1991; Merck, 1989).

Physical Properties of Phosphine

Synonyms: celphos; delicia; detia gas ex-B; hydrogen phosphide; phosphorus trihydride

Molecular Weight:	34.00
Boiling Point:	-87.7 °C
Melting Point:	-133 °C
Vapor Density:	1.17 (air = 1)
Vapor Pressure:	20 atm at -3 °C
Autoignition Temperature:	212 °C
Conversion Factor:	1 ppm = 1.39 mg/m ³

(HSDB, 1991; Merck, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Phosphine is used in the preparation of flame retardants, organic chemicals, and phosphonium halides, doping agents for n-type semiconductors, polymerization initiators, and condensation catalysts (HSDB, 1991). Phosphine is a breakdown product of aluminum phosphide (DPR, 1997). For more information on aluminum phosphide, see the fact sheet on Aluminum Compounds.

The primary stationary sources that have reported emissions of phosphine in California are

manufacturers of preserved fruits and vegetables, public warehousing, and manufacturers of sugar and confectionary products (ARB, 1997b).

B. Emissions

The total emissions of phosphine from stationary sources in California are estimated to be at least 3,000 pounds per year, based on data reported under the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Phosphine is formed in small concentrations from decaying organic matter containing phosphorus (Merck, 1989).

AMBIENT CONCENTRATIONS

Phosphine and its species are routinely monitored by the statewide Air Resources Board air toxics network. The network's mean concentration of phosphine (including its species) from January 1995 through December 1995 is estimated to be 38.6 nanograms per cubic meter (ng/m³) or 0.03 parts per billion (ARB, 1996b).

INDOOR SOURCES AND CONCENTRATIONS

No information on indoor sources and concentrations of phosphine was found in the readily-available literature.

ATMOSPHERIC PERSISTENCE

Phosphine exists in the atmosphere in the gas phase. The dominant chemical loss process for phosphine in the troposphere is expected to be by reaction with the hydroxyl (OH) radical. Based on this reaction, the atmospheric half-life and lifetime of phosphine is calculated to be 0.7 days and 1 day, respectively (Atkinson, 1989). Reaction products are not presently known.

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of December 1996, for non-cancer health effects, phosphine did not contribute to a total chronic or acute hazard index greater than 1 in any of the risk assessments (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to phosphine are inhalation and ingestion (HSDB, 1991).

Non-Cancer: Phosphine is extremely irritating to the lungs. Overexposure may cause headaches, dizziness, fatigue, burning substernal pain, nausea, vomiting, gastrointestinal distress, cough with fluorescent green sputum, labored breathing, pulmonary irritation, pulmonary edema, and tremors. Long-term exposure may cause inflammation of the nasal cavity and throat, cardiorespiratory and central nervous system effects, jaundice, liver effects, and increased bone density (U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 10 micrograms per cubic meter is listed for phosphine in the California Air Pollution Control Officers Association Air Toxics “Hot Spots” Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoints considered for chronic toxicity are the cardiovascular or blood system, central or peripheral nervous system, gastrointestinal system and liver (CAPCOA, 1993). The United States Environmental Protection Agency (U.S. EPA) has established an oral Reference Dose (RfD) of 3×10^{-4} milligrams per kilogram per day for phosphine based on body weight and clinical parameters in animal studies. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic, non-cancer effects. The U.S. EPA has not established a Reference Concentration (RfC) (U.S. EPA, 1994a).

No information on adverse reproductive or developmental effects in humans is available. In a study of rats exposed to phosphine in their diet, no impairment of reproductive function was noted (U.S. EPA, 1994a).

Cancer: No information is available regarding the carcinogenic effects of phosphine in humans. No evidence of carcinogenic effects was reported in two studies of rats exposed by ingestion. The U.S. EPA has classified phosphine in Group D: Not classifiable as to human carcinogenicity (U.S. EPA, 1994a). The International Agency for Research on Cancer has not classified phosphine with respect to potential carcinogenicity (IARC, 1994).

